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If the well-known saying of Goethe "Denn eben wo es an Begriffen fehlt, da stellt ein Wort zur rechten Zeit sich ein" applied in the past to any group of phytochemical substances, its application to plant pigments was certainly justifiable. Such designations as "the green coloring matter of leaves," or "the blue coloring matter of flowers" are not as euphonious as chlorophyll and anthocyanin, but it is doubtful if they would have done as much harm. These words of Greek origin certainly enjoyed the advantage of brevity as well as of euphony, but they also carried with them something of a notion that they stood for more or less definite chemical compounds about which we flattered ourselves that we knew something, although this knowledge had not crystallized into structural formulas, the chemical shorthand expression of their properties. Plant physiologists were not the only sinners in this direction, but chemical literature is almost equally replete with illustrations of such misleading use.

To any one who is at all acquainted with the chemical literature on plant pigments, the researches of Willstaetter and his collaborators, as they have made their appearance in the *Annalen* since 1906, have come as a great relief. It is equally a relief, though of a different kind, to have the results, as laid down in these twenty-two *Abhandlungen*, together with more recent ones, coordinated to a "gemeinsames Ganzes." If we have admired Willstaetter's experimental researches, we are more grateful for his literary labors that have made available to us the results of his labors in the laboratory.

Even a partial review of the contents of this monograph would lead too far for a non-technical journal like SCIENCE. Suffice it to point out that all aspects of the subject, it would seem, are treated in such a manner that the person who desires to inform himself in a general way can use the book to advantage as well as the investigator who is particularly interested in this special field. Plant physiologists as well as chemists will find the volume

replete with useful information as well as interest.

We have here another illustration of German "Gruendlichkeit" that is not impaired by specialization and detail, but that has accomplished the best because of special effort on the one hand and because of the application of a wide general knowledge to a restricted problem on the other hand. It reminds one of Berzelius's letter to Woehler in which the older Swedish chemist pats his young German friend on the back, as it were, when, in words that one would scarcely look for to a chemist, he makes light of the more or less accidental discovery of a new element by Sefstroem—a discovery that had just escaped Woehler—as compared with the brilliant and far-reaching researches of the man to whom is commonly attributed the first organic "synthesis."

If the Germans have felt the necessity of supplementing the research activities, that have so long been characteristic of the scientific institutes of their universities, by the Kaiser Wilhelm Foundation, this contribution from the "Kaiser Wilhelm-Institut fuer Chemie" may well serve as a good omen of the excellent results that may be expected in the future from this new institution devoted to scientific research.

If the knowledge that we now have to deal with definite chemical substances when we speak of the "Abbau" products of chlorophyll and its partial synthesis, affords a feeling of satisfaction, the excellent microphotographic views of the crystals of these substances assist in strengthening the feeling that our present knowledge, as elucidated by Willstaetter, rests on a good foundation.

E. K.

The Principles of Stock-breeding. By JAMES WILSON, M.A., B.Sc., Professor of Agriculture in the Royal College of Science for Ireland, Dublin, author of "The Evolution of British Cattle and the Fashioning of Breeds." Published in 1912 by Vinton and Company, Ltd., 8 Bream's Buildings, Chancery Lane, E. C., London. 8vo. Pp. vi + 146.

This book is an exposition of the recently

discovered principles of heredity, and an attempt to demonstrate their utility in practical stock-breeding operations, with especial reference to the economic production of milk and butter. In the first chapters Professor Wilson develops, in a manner that should interest both the student of heredity and the practical breeder, the history of the theory of stock-breeding, beginning with the old theories, which he designates: "like begets like," "inbreeding," "pedigree" and "evolution." Concerning these theories he says, "They have been tried in Britain for varying periods of time: like begets like for centuries, inbreeding for nearly a century and a half, and pedigree for nearly a century. Evolution has been in stock-breeders' minds vaguely for nearly a half century." He describes the rise of each of these notions, and tells how each in turn was adopted by the practical breeders and how each in turn was found to possess exceptions and shortcomings which the breeder was bound to recognize. He then points out the manner in which the aggravating exceptions to these accepted principles led to further investigations, and finally to the discovery of other principles at first accepted all too inclusively, only to be subjected to the same purifying process.

The history of the making of the breeds of British cattle is always a fascinating story, and Professor Wilson, through his wide acquaintance with the history of breeding, describes the inestimable service rendered to livestock interests through the operations, largely by the process of inbreeding, first of all by Bakewell with many breeds, then by Hugh Watson with Angus cattle, and Cruickshank with Shorthorns, and by Sir George Macpherson Grant with Aberdeen-Angus cattle. The greatness of the English breeders is demonstrated by their willingness to try out all theories that promised utility. They threshed out the grain from the chaff; not only did they try out the old theories just mentioned, but they tried out with equal avidity "reversion," "maternal impression," "accident and mutation" and "telegony." The fact that these latter theories yielded no "fruit" did not

daunt the British breeder, and he is now in the midst of trying out Mendelism. If the principles of Mendelism, when applied to practical breeding, can yield half as much as the older inbreeding operations, then Professor Wilson's appeal and advice will prove to have been wholesome and good.

There is in this book a vigorous protest against pedigree breeding in the old sense, and a continual appeal for breeding for traits which can be controlled by the applications of Mendelian principles. The author contends that the herd-books and stud-books are the tyrants that keep modern breeds stationary; that fashion, as much as utility, seems to rule the older breeds, the one exception being the thoroughbred horse, which is continually being put to the best of tests, namely, the track, and winners and breeders of winners are in demand regardless of family tradition. He prophesies that one of the principal lines of development of stock-breeding in the future will be the transferring of traits of utility from one breed to another, and is optimistic as to the possibilities of such a process.

The author describes the instances wherein traits of domestic animals appear to behave in Mendelian fashion, and he attempts to give practical advice as to the proper method of breeding for what he is pleased to call the three economic factors, namely, size, yield and quality.

In reference to the first, size, it appears that the first cross between cattle of a small and a large breed will give, quite uniformly, an intermediate-sized animal, but it is not clear whether such animals when bred together will throw offspring which segregate back to the two grandparental sizes. He protests against the method of breeding the half-breed offspring back to one of the pure breeds, claiming, quite properly it appears, that the correct way to secure new combinations is to breed the F_1 hybrids together. He protests also against too close an adherence to the theory of fancy points, holding that there is not always the high correlation between fashionable points and utility that many breeders seem to feel exists.

In discussing the second factor, the quality of milk yield, the author describes an experiment conducted by Count Ahlefeldt, wherein Red Danish cattle, with an average yield of 3.42 per cent. milk, were crossed with Jerseys averaging a yield of 5.22 per cent. milk. The hybrid offspring averaged a yield of 4.15 per cent. These cross-bred animals were bred back to the parental Jerseys. The author points out that if quality of yield behaves in Mendelian fashion, one half of the animals, regardless of their other traits, would yield milk of Jersey quality, and one half of them would yield the cross-breed quality. Analyzing the table given by the author, we find that of the 15 offspring of such matings 7 yielded 4.7 per cent. or richer milk, and 8 yielded below this quality. If the types of offspring from the *Cross by Red Danish*, and *Cross by Cross* matings approximate as closely to the Mendelian expectation as the *Cross by Jersey* mating just described, and the matings are extensively made, then, even though yield may be governed by a host of unit traits, they would appear, for practical purposes, to move in synchronism, and the practical breeder would have a working principle of value. One would suspect, however, that such a complex thing as quality would shatter in the subsequent inbreeding of hybrids. More data are required.

The author points out that yield of butter is not a fair basis for breeding selection, because butter yield is dependent upon two factors, namely, quality and quantity of milk. Each one of these factors should be taken as a basis for selection, and a combination of high quality and high yield sought by Mendelian methods. He sees no sound reason why high quality and great quantity of yield should be mutually exclusive; he believes they can be combined by Mendelizing.

If any adverse criticism were to be rendered, it must be said that throughout the book the author disregards the exceptions to the rule when describing the heredity of an animal characteristic which appears to approximate Mendelian expectation. For instance, continual reference is made to color inheritance in Shorthorn cattle, assuming the case exactly

parallel to that of the Andalusian fowl, wherein the first generation hybrid is a blend and segregation occurs in the second generation according to Mendelian formula. Whereas it has been found that Shorthorn coat color is neither one unit nor a single group of units, but behaves in heredity as two units, or unit groups, the areas for the white hairs in the roan behaving as one unit, and the areas for the red as another. Moreover, a red mated with a red does not *always* produce a red, although it *generally* does so. If the whole coat color were a single unit, behaving in Mendelian fashion, then *red by red* would produce only red. To a well-known exception of this sort the author should not be blind; to him, as he so clearly points out in reference to the older studies and theories, it should point toward future studies and discoveries, each with its gold and dross. It would seem more reasonable continually to urge the analysis of gross somatic characteristics into heritable units which, without exception, behave according to rule. However, a rule that works nine times out of ten is a good one for the practical man to follow, and to him is an instrument of inestimable value, although to the theorist the one exception is the thing that commands his interest and work.

To summarize, the book is a special plea for the practical application of the Mendelian principles to animal breeding, and as such, the case is better established than in any other practical breeder's guide with which the reviewer is acquainted. In general, it recognizes the limitations of the present knowledge of Mendelian traits in domestic animals, and in a wholesome manner urges further investigation, as well as the courageous application of current theories by practical breeders.

The author's style is literary, his English clear, and his argument is easy to follow.

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The First Principles of Evolution. By S. HERBERT. London, A. & C. Black; New York, The Macmillan Co. 1913.